RAIO-0718-60971

July 20, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 481 (eRAI No. 9368) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 481 (eRAI No. 9368)," dated May 21, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 9368:

- 15.06.03-4

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 481 (eRAI No. 9368). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

This letter and the enclosed responses make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9368, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9368, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0718-60972

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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9368, proprietary

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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9368, nonproprietary

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NuScale Power™

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9368
Date of RAI Issue: 05/21/2018

NRC Question No.: 15.06.03-4

Title 10 of the Code of Federal Regulations (10 CFR) 52.47(a)(2)(iv) requires that an application for a design certification include a final safety analysis report (FSAR) that provides a description and safety assessment of the facility. The safety assessment analyses are done, in part, to show compliance with the radiological consequence evaluation factors in 52.47(a)(2)(iv)(A) and 52.47(a)(2)(iv)(B) for offsite doses; and 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 19 for control room radiological habitability.

The radiological consequences of design basis accidents are evaluated against these regulatory requirements and the dose acceptance criteria given in Standard Review Plan (SRP) Section 15.0.3. NRC staff needs to ensure that a suitably conservative estimate is determined for the radiological release associated with the steam generator tube rupture event (SGTR). In addition, 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 54, “Piping systems penetrating containment,” requires piping systems penetrating primary reactor containment to be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities that reflect the importance to safety of isolating these piping systems.

Steam generator (SG) overfilling is a major concern for an SGTR related to the potential loss of secondary side integrity and extended radioactivity releases to the atmosphere. As a result of the 1982 SGTR event at the Ginna Plant, the NRC questioned equipment capability and assumptions used in FSAR analyses and issued Generic Letter 89-19.

As indicated by the applicant in FSAR Tier 2, Section 15.6.3.1, “[t]he design of the helical coil steam generators (HCSGs), described in Section 5.4, is different from the design of SGs in conventional pressurized water reactors [PWRs] because primary coolant is located on the outside, or shell side, of the tubes.” In addition, the staff notes that the inventory of the SGs is also very small, so the radiological consequences of a SGTR could be more severe than for conventional PWRs. The mitigation of the SGTR event is dependent upon closure of the main steam isolation valve (MSIV) or the secondary MSIV, depending on the single active failure assumed.

It is not clear to the staff that NuScale's submitted limiting case sequence of events and assumptions would maximize the RCS mass release prior to the secondary main steam isolation valve closing. The maximum RCS mass release affects the input to the dose analysis

and establishes potentially the worst conditions (e.g., quality) in which the MSIV and secondary MSIV are required to close. In response to RAI 8794 the applicant indicated that the MSIV and secondary MSIV are designed to close in steam and liquid conditions but did not provide sufficient detail and justification for the staff to make a regulatory finding.

Therefore, the applicant is requested to provide additional information justifying that a conservative RCS mass release prior to the closure of secondary MSIV is calculated, including uncertainties in friction and form losses in the tubes, inlet orifices and tube sheet, and that the MSIV and secondary MSIV will close under the worst expected steam generator failure conditions.

NuScale Response:

The secondary integrity issue identified in Generic Letter 89-19 does not apply to the NuScale design because, unlike traditional PWRs, the secondary design pressure, between the feedwater regulating valves and the backup secondary isolation valves is rated to the same pressure as the reactor pressure vessel (RPV). Therefore, after secondary isolation, the shell and tube side of the steam generator can fully equalize in pressure without challenging the secondary design pressure. For this event, small secondary volume of the NuScale design is a beneficial design feature because it allows for rapid pressure equalization between the primary and secondary which mitigates the overall inventory loss. In addition both the reactor safety valves and steam generator thermal relief valves are located inside containment so over pressurization actuation of either of these would not lead to atmospheric releases. Therefore the steam generator tube failure event for the NuScale design is much less severe than a typical PWR which is evidenced in the simplicity of event mitigation safety features and low overall dose consequences (approximately 450 percent margin to control room dose limits) as presented in FSAR Table 15.0-12.

The break model methodology applied for the steam generator tube failure event applies the {{

}}$^{2(a),(c)}$ The methodology applied to identify the limiting steam generator tube failure scenario for radiological consequence presented in the FSAR is consistent with the Non-Loss of Coolant Accident Analysis Methodology topical report (TR-0516-49416-P, Rev. 0).

In the radiological analysis of the event, all the mass that flows through the failed tube is assumed to be released to the environment. Therefore, changes to the hydraulic resistances on the secondary side would not impact the maximum overall mass release.

For the NuScale design, the following considerations are key to achieving a maximal break mass release:

1. **Maximal drop in pressurizer level before isolation provides a primary indication of maximal mass release.** To maximize mass release, the pressurizer level is biased high and drops as low as possible before isolation. Isolation can occur in response to a low-low pressurizer level signal, but in practice the expansion of the vapor space due to drop in level causes secondary isolation on low pressurizer pressure signal (1600 psia) to occur before the low-low pressurizer level signal (<20%) is reached because the reactor and pressurizer heaters are tripped at low pressurizer level (<35%). Thus a low pressurizer pressure signal is indicative of reaching the lowest level in the pressurizer possible before isolation. The sensitivities verified that the limiting signal for maximal mass release is a low pressurizer pressure signal.
2. **Heating of the RPV liquid after transient initiation increases mass release.** This is primarily due to the fact that heating causes RPV liquid expansion and delays actuation of the low pressurizer level signal while cooling the liquid contracts the liquid and causes actuation sooner. For this reason, beginning of cycle reactor kinetics increased mass release since the reactivity insertion caused additional heating of the RPV liquid and delayed the low pressurizer level signal.
3. **High density at the break is limiting.** An RPV temperature that is biased low leads to a higher density at the break. The higher density break flow results in less decrease in level per mass ejected from the break, and sensitivities confirmed this to be limiting.
4. **Break flow rate is important after reactor trip, but maximal break flow is not necessarily limiting.** Reactor trip occurs in response to a low pressurizer level signal. After reactor trip, the RPV liquid starts to cool and level drops in the pressurizer due to density changes. At this point a competing condition is established where level will drop due to cooling and due to break flow. Thus a maximal break flow is limiting unless there is an impact on the RPV liquid heat transfer that leads to earlier isolation. The sensitivities verified that the largest break flow is not limiting. For example, breaks located at the bottom of the SG tube had a higher break flow than breaks located at the top of the steam generator tube. Despite the higher break flow, the breaks at the bottom of the steam generator tube were not limiting because flow into the steam generator tube sheet enhanced the heat transfer from the RPV to the steam generator and caused the pressurizer level to drop more rapidly leading to an earlier reactor trip on low pressurizer level followed by a low pressurizer pressure trip signal for secondary isolation.

The sensitivities performed verified that these are the primary factors that influence mass release. The sensitivity included the system parameters that have an important impact on drop in pressurizer level, RPV liquid heating after transient intitiation, density at the break, and break flow rate. Break location and break size are primary factors that influence break flow rate and were included in the sensitivities to ensure a limiting break flow rate for maximal mass release was achieved in the analysis.

As described in the supplemental response to eRAI 8794, Question 15.06.03-2 (Letter RAIO-0618-60721 submitted on June 29, 2018) the secondary isolation valves are qualified based on the events that generate the maximum forces, based on differential pressure across the valve, under which the valve actuators must be designed to ensure closure of the valve. In the case of both the feedwater isolation valves (FWIVs) and MSIVs, this is determined to be the secondary pipe break accidents where the actuators are required to close the valve under the force of fully developed pipe break flowrates. Regardless of the actual steam quality conditions for the steam generator tube failure event, the flow through the MSIV and the differential pressure across the valve is close to normal operating conditions. Therefore, it is determined the steam generator tube failure event is well bounded by the existing qualification requirements of the MSIV.

In summary, the small secondary volume and high design pressure of the secondary system is an asset for the NuScale design by allowing full pressure equalization between the primary and avoiding the need for the actuation of a lower pressure main steam safety relief valve which is problematic for traditional PWRs. The existing steam generator tube failure sensitivity cases are sufficient to identify the optimal break flowrate to maximize the mass release and dose consequences. Finally, the qualification of the MSIVs is sufficient to ensure the valves will close under all possible steam generator tube failure conditions.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0718-60972

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NuScale Power, LLC

AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
    a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
    b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
    c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
    d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
    e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the process and method by which NuScale develops its safety analysis of the NuScale Power Module.

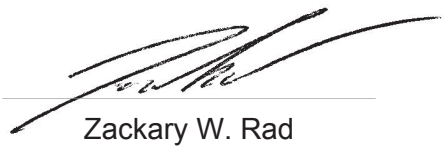
    NuScale has performed significant research and evaluation to develop a basis for this process and method and has invested significant resources, including the expenditure of a considerable sum of money.

    The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

    If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information No. 481, eRAI No. 9368. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
    a. The information sought to be withheld is owned and has been held in confidence by NuScale.
    b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
    c. The information is being transmitted to and received by the NRC in confidence.
    d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
    e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 20, 2018.



Zackary W. Rad